Final Performance Report For:
NOAA NEAQS - ITCT 2K4 (ICARTT)

Georgia Tech. Project # C13

Award No: NA04OAR4310089

Award Period: 06/01/2004 – 05/31/2006

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This project was set to expired on June 30, 2006, however, a no-cost extension was requested and granted, extending the deadline to June 30, 2007. The monies for this project have now been expended.

The project goal was to perform measurements of aerosol bulk chemical composition on the NOAA WD-P3 aircraft during ICARTT (NEAQS 2004) to characterize and investigate anthropogenic species transported from northeastern America to the Atlantic. This work was completed and the data quality assured and submitted to the archive. The data has been analyzed and our research group has produced four (4) papers. The findings are summarized below. (Papers are available at http://www.aerosols.eas.gatech.edu/Papers_List.htm)

Peltier, R. E., A. P. Sullivan, R. J. Weber, A. G. Wollny, J. S. Holloway, C. A. Brock, J. A. d. Gouw, and E. L. Atlas, 2007b, No evidence for acid-catalyzed secondary organic aerosol formation in power plant plumes over metropolitan Atlanta, Georgia: Geophys. Res. Lett., v. 34, p. L06801, 10.1029/2006GL028780.
Peltier et al. investigated the influence of acidic aerosols on the formation of secondary organic aerosol (SOA) in the Atlanta metropolitan area, a region high in both anthropogenic and biogenic VOCs. Results from the NOAA WD-P3 aircraft during ICARTT flights conducted over Atlanta show that there is no measurable increase in organic aerosol mass in highly acidic power plant plumes, compared to more neutral aerosol conditions in the surrounding region. Our results show that in Atlanta, power plant plumes do produce conditions that enhance SOA the formation of SOA. This is a major finding since laboratory measurements and recent published model simulation have suggested so-called acid-catalyzed reactions will substantially increase SOA production and account for high ambient organic aerosol loadings than predicted by model simulations that do not consider it.

Peltier, R., A. Sullivan, C. Hennigan, C. Brock, A. Wollny, J. Holloway, J. d. Gouw, C. Warneke, and R. J. Weber, 2007a, Airborne measurements of fine particle ionic and water-soluble organic carbon concentrations during ICARTT: Atm. Chem. Phys., v. in review.
This paper is in the final stages of review and likely to be accepted in the near future. It summarizes the NOAA WD-P3 aerosol composition measurements during ICARTT, providing an analysis of the spatial distributions of sulfate and carbonaceous aerosols, identification of major sources, analysis of ion balances (aerosol acidity), and a mass closure analysis. These results, in conjunction with a model simulation involving our data (Heald et al., 2006), provide a valuable climatological summary on fine aerosol composition in the northeastern US in the summer of 2004.

Sullivan, A., R. E. Peltier, C. A. Brock, J. A. d. Gouw, J. S. Holloway, C. Warneke, A. G. Wollny, and R. J. Weber, 2006, Airborne measurements of carbonaceous aerosol soluble in water over northeastern United States: Method development and an investigation into water-soluble organic carbon sources: J. Geophys. Res., v. 111, D23S46, p. 10.1029/2006JD007072.
A new method for airborne measurements of water-soluble organic carbon (WSOC) aerosol is present in this paper. The sources of WSOC are investigated. Two major sources were

identified, biomass burning emissions and SOA from urban emissions. No clear evidence was found for a strong biogenic SOA source. Studies from tracking the evolution of urban plumes show that SOA is formed with a time constant of roughly 24 hours. These results are consistent with an earlier study (de Gouw et al., 2005) and provide new insights into the poorly understood mechanism of SOA formation.

Weber, R. J., A. P. Sullivan, R. E. Peltier, A. Russell, B. Yan, M. Zheng, J. A. d. Gouw, C. Warneke, C. Brock, J. S. Holloway, E. L. Atlas, and E. Edgerton, 2007, A study of secondary organic aerosol formation in the anthropogenic-influenced southeastern USA: J. Geophys. Res., v. in press.

This paper focuses on comparing data collected during ICARTT in plumes from New York City (NYC) to the metro Atlanta plume. It provides new results that question the current view that SOA in urban regions with high biogenic and anthropogenic emissions is due mainly to biogenic VOCs. Measurements of biogenic VOCs, and their oxidation products, from the NOAA WD-P3 show much higher biogenic VOCs concentrations over Atlanta compared to NYC plumes, however, the water soluble fraction of the organic aerosol (WSOC, a measure of SOA) was correlated with anthropogenic emissions (e.g., WSOC CO r^2=0.80) and were in similar proportions in Atlanta and NYC plumes. These findings have significant implications for methods proposed to improve air quality. Our finding that the processes is intimately linked to an anthropogenic species indicates that if this unknown species could be identified and concentrations reduced, biogenic contributions to PM1 would also decrease. Or, that most SOA was anthropogenic and that current radiocarbon methods used to delineate anthropogenic and biogenic SOA significantly over predicts the biogenic contribution. The paper is accepted and currently in the copy editing process.

In addition papers resulting directly from this funding, additional papers will be submitted based on data we generated in this project (Brock et al., 2007; de Gouw et al., 2007).

References

Brock, C. A., A. Sullivan, R. Peltier, R. J. Weber, J. deGouw, T. S. Bates, T. Quinn, A. M. Middlebrook, D. M. Murphy, E. Atlas, A. Stohl, M. Trainer, O. R. Cooper, F. C. Fehsenfeld, J. S. Holloway, G. Hubler, P. K. Hudson, J. A. Neuman, T. B. Ryerson, C. Warneke, and J. C. Wilson, 2007, Chemical and microphysical evolution of aerosols transported from the east coast of United States: J. Geophys. Res., v. in prep.

de Gouw, J. A., C. Brock, C. Warneke, J. S. Holloway, B. M. Lerner, E. J. Williams, W. C. Kuster, P. D. Goldan, C. J. Senff, M. Trainer, F. C. Fehsenfeld, A. P. Sullivan, R. E. Peltier, R. J. Weber, P. K. Quinn, T. S. Bates, T. B. Onasch, and E. L. Atlas, 2007, Direct emissions and secondary production of particulate organic matter in urban plumes in the northeastern United States: Atm. Chem. Phys., v. submitted.

de Gouw, J. A., A. M. Middlebrook, C. Warneke, P. D. Goldan, W. C. Kuster, J. M. Roberts, F. C. Fehsenfeld, D. R. Worsnop, M. R. Canagaratna, A. A. P. Pszenny, W. C. Keene, M. Marchewka, S. B. Bertman, and T. S. Bates, 2005, The budget of organic carbon in a polluted atmosphere: Results from the New England Air Quality Study in 2002: J. Geophys. Res., v. 110, p. 10.1029/2004JD005623.

Heald, C. L., D. J. Jacob, S. Turquety, R. C. Hudman, R. J. Weber, A. P. Sullivan, R. E. Peltier, E. L. Atlas, J. A. d. Gouw, C. Warneke, J. S. Holloway, J. A. Neuman, F. M. Flocke, and J. H. Seinfeld, 2006, Concentrations and sources of organic aerosols in the freee troposphere over North America: J. Geophys. Res., v. 111, p. D23S47, 10.1029/2006JD007705.